IRAC
Insecticide Resistance Action Committee
eConnection

SUMMARY

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About This Issue

Welcome to another IRAC eConnection newsletter, now with a new format. As always, we try to bring you interesting and informative articles about the work of IRAC and keep you updated on developing insecticide resistance issues around the world.

In this issue we report on the 46th IRAC International Meeting and provide updates on new resources and publications from the IRAC MoA, Public Health and Methods Teams. We also spotlight some of the recent resistance articles that have appeared in journals over the last few months along with the usual summary of IRAC activities and details of upcoming conferences and symposia. IRAC has been busy providing IRM education in S.E. Asia and we provide an update on recent workshops in Thailand and the Philippines.

Remember, if you have any news or resistance topics of interest, please let us know so that we can inform others in the IRAC Network. We hope you enjoy the issue.

46th IRAC International Meeting

IRAC Annual International Meeting, Brussels 2011

IRAC International held their 46th International Meeting in the CropLife offices in Brussels this year. It was our biggest ever meeting with 46 participants representing the 15 IRAC Executive Member Companies, as well as visitors from the European resistance action groups and many other IRAC representatives from around the world. The meeting consisted of a mixture of concurrent IRAC working group sessions, a meeting of the Executive Committee and an International review day. There was an excellent exchange of information with around 40 presentations made during the course of the 4 days of meetings. In addition the 2011/12 goals and objectives for the various IRAC working groups were discussed and agreed.

The IRAC International Elected Officers were unanimously re-elected for a further year:

Chairman: Ralf Nauen, BayerCrop Science

Treasurer: Nigel Armes, BASF

Deputy Chair: Russell Slater, Syngenta

Deputy Chair: Jonathan Henen, Makhteshim Agan

Spotlight on recent Insecticide Resistance Articles in Publications

A shift in neonicotinoid sensitivity was reported in cotton aphid (*Aphis gossypii*) populations collected from Australian cotton [1]. Although the observed shifts in sensitivity could be considered small, they are associated with field failures of the related neonicotinoid products. Likewise significant variations in neonicotinoid and organophosphate susceptibility has also been observed in adult Asian citrus psyllid (*Diaphorina citri*) collected in Florida, USA [2] These are the first reported cases of resistance to this class of chemistry for this invasive pest. A mutation of the nicotinic acetylcholine receptor associated with neonicotinoid resistance in field populations of agricultural pests is also reported for the first time [3]. Green peach aphids (*Myzus persicae*) collected from peach orchards in France demonstrated high levels of resistance to neonicotinoid insecticides, with resistance which was associated with a single point mutation in the loop D region of the nAChR β1 sub unit.

Insecticide resistance in rice planthoppers continues to be a major concern in Asia. Although the brown planthopper (*Nilaparvata lugens*) has been the main subject of study, the small brown planthopper (*Laodelphax striatellus*) is also a major pest. Japanese immigrant populations of this species of planthopper were analysed for their insecticide susceptibility in 2008 [4] and although susceptibilities varied amongst populations, resistance to fiprole and neonicotinoid insecticides were observed both separately and in combination within individual populations. In a separate study [5] fiprole resistance in this species has been associated with an A2'N point mutation, which had previously been documented in whitebacked planthopper (*Sogatella furcifera*).

The control of the diamondback moth (*Plutella xylostella*) has long been an issue for growers globally and this is demonstrated by recent studies of insecticide susceptibility in the Guangdong province of China [6] and Pernambuco state in Brazil [7 & 8]. In Guangdong province, although susceptibility varied amongst the populations collected, high levels of resistance were observed for all the insecticide chemistries tested in the study (avermectin, diacylhydrazine, chlorfenapyr and carbamate). Similar observations were made in selected populations of the moth in Brazil, with high levels of resistance reported for benzoyl urea, avermectin, pyrethroid and indoxacarb insecticides.

References:

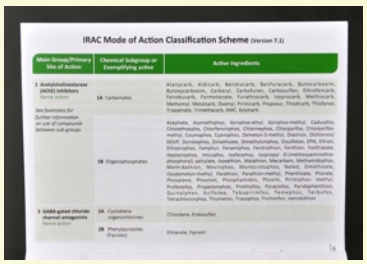
1. Herron GA, Wilson LJ, Neonicotinoid resistance in *Aphis gossypii* Glover (Aphididae: Hemiptera) from Australian cotton. Australian Journal of Entomology **50 (1)**: 93-98 (2011).
2. Tiwari S, Rogers ME, Stelinski LL, Insecticide susceptibility levels among Asian citrus psyllid populations in Florida and evaluating the efficacy of selected insecticides against *Candidatus* Liberibacter asiaticus infected psyllid. Abstracts of Papers, 241st ACS National Meeting & Exposition, Anaheim, CA, United States, March 27-31 (2011)
3. Bass C, Puinean AM, Andrews M, Culter P, Daniels M, Elias J, Paul VL, Crossthwaite AJ, Denholm I, Field LM, Foster SP, Lind R, Williamson, MS, Slater R. Mutation of a nicotinic acetylcholine receptor β subunit is associated with resistance to neonicotinoid insecticides in the aphid *Myzus persicae*. BMC Neuroscience 12, 51 (2011)
4. Sanada-Morimura S, Sakumoto S, Ohtsu R, Otuka A, Huang SH, Thanh DV, Matsumura M, Current status of insecticide resistance in the small brown planthopper, *Laodelphax striatellus*, in Japan, Taiwan, and Vietnam. Applied Entomology and Zoology, **46(1)**, 65-73 (2011).
5. Nakao T, Kawase A, Kinoshita A, Abe R, Hama M, Kawahara N, Hirase K, The A2'N mutation of the RDL gamma-aminobutyric acid receptor conferring fipronil resistance in *Laodelphax striatellus* (Hemiptera: Delphacidae). Journal of economic entomology, **104 (2)** 646-652 (2011)
6. Zhou, LJ, Huang JG, Xu, HH, Insecticide resistance of *Plutella xylostella* from fields of Pearl River Delta. Journal of South China Agricultural University **32 (1)** 45-48 (2011).
7. Santos V, Siqueira H, Silva J, Farias M, Insecticide resistance in populations of the diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae), from the state of Pernambuco, Brazil. Neotropical entomology **40 (2)** 264-270 (2011).
8. Oliveira AC, Siqueira HAA, Oliveira JV, Silva JE, Michereff Filho M, Resistance of Brazilian diamondback moth populations to insecticides. Scientia Agricola. **68 (2)** 154-159 (2011).

New MoA Classification Booklet

The second edition of the MoA mini-booklet has just been printed and copies are now available for distribution. The booklet is based on the recently updated IRAC MoA Classification Scheme (version 7.1). Changes included some minor revisions and the addition of some new actives:

Group 25: Cyflumetofen
Group 28: Cyantraniliprole
Group 6: Lepimectin
Group un: Pyrifluquinazon

The pages in the booklet showing the active ingredients in different MoA groups suitable for each of the main pest groups have also been updated to reflect the current situation.



IRAC Public Health Team

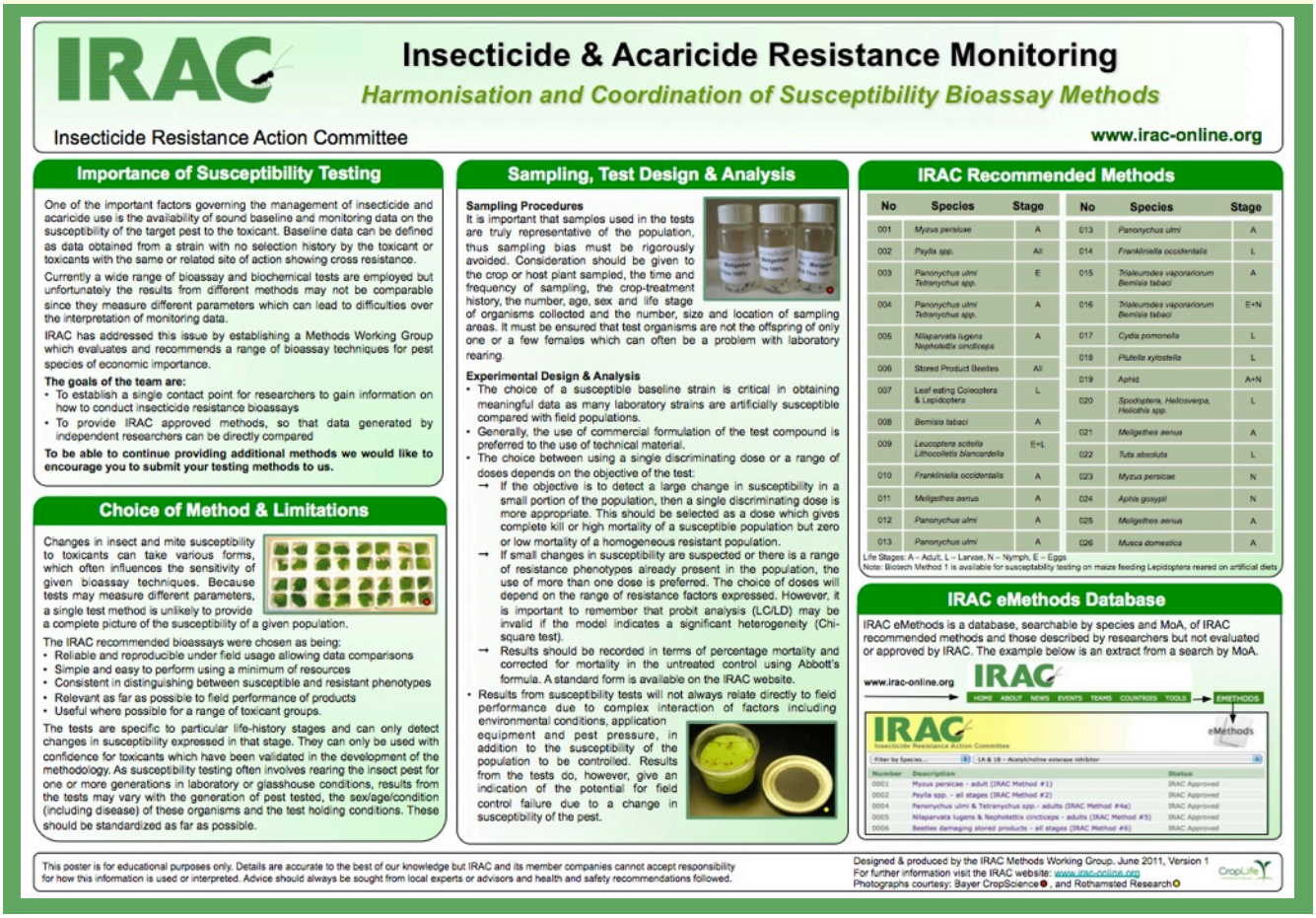
Updated IRAC Vector Manual

The second edition of the very popular manual "Prevention and Management of Insecticide Resistance in Vectors of Public Health Importance" was published online at the end of last year and at a recent meeting of the IRAC Public Health Team, printed versions of the manual were released. The manual has been extensively updated with further figures, graphs and some very useful flowcharts. Copies are available from the team members or from the IRAC Coordinator via the website.

New Susceptibility Test Methods Poster

A new poster has been developed by the IRAC Methods Team describing the basic principles of monitoring insect and mite susceptibility to toxicants and the importance of using standardized test methods for comparison of results. The team, in conjunction with the other IRAC working groups, has recently added further IRAC approved methods for specific MoA groups for species such as *Tuta absoluta, Myzus persicae, Aphis gossypii, Meligethes aenus* and *Musca domestica*.

The full method details can be downloaded from the Method's Team page on the IRAC website. In addition all the IRAC Methods as well as those described by researchers, but not evaluated or approved by IRAC, can be searched by MoA or species using the IRAC eMethods database available via the eTools link, again on the IRAC website.



IRAC

Insecticide & Acaricide Resistance Monitoring

Harmonisation and Coordination of Susceptibility Bioassay Methods

Insecticide Resistance Action Committee

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Importance of Susceptibility Testing

One of the important factors governing the management of insecticide and acaricide use is the availability of sound baseline and monitoring data on the susceptibility of the target pest to the toxicant. Baseline data can be defined as data obtained from a strain with no selection history by the toxicant or toxicants with the same or related site of action showing cross resistance.

Currently a wide range of bioassay and biochemical tests are employed but unfortunately the results from different methods may not be comparable since they measure different parameters which can lead to difficulties over the interpretation of monitoring data.

IRAC has addressed this issue by establishing a Methods Working Group which evaluates and recommends a range of bioassay techniques for pest species of economic importance.

The goals of the team are:

- To establish a single contact point for researchers to gain information on how to conduct insecticide resistance bioassays
- To provide IRAC approved methods, so that data generated by independent researchers can be directly compared

To be able to continue providing additional methods we would like to encourage you to submit your testing methods to us.

Choice of Method & Limitations

Changes in insect and mite susceptibility to toxicants can take various forms, which often influences the sensitivity of given bioassay techniques. Because tests may measure different parameters, a single test method is unlikely to provide a complete picture of the susceptibility of a given population.

The IRAC recommended bioassays were chosen as being:

- Reliable and reproducible under field usage allowing data comparisons
- Simple and easy to perform using a minimum of resources
- Consistent in distinguishing between susceptible and resistant phenotypes
- Relevant as far as possible to field performance of products
- Useful where possible for a range of toxicant groups.

The tests are specific to particular life-history stages and can only detect changes in susceptibility expressed in that stage. They can only be used with confidence for toxicants which have been validated in the development of the methodology. As susceptibility testing often involves rearing the insect pest for one or more generations in laboratory or glasshouse conditions, results from the tests may vary with the generation of pest tested, the sex/age/condition (including disease) of these organisms and the test holding conditions. These should be standardized as far as possible.

Sampling, Test Design & Analysis

Sampling Procedures

It is important that samples used in the tests are truly representative of the population, thus sampling bias must be rigorously avoided. Consideration should be given to the crop or host plant sampled, the time and frequency of sampling, the crop-treatment history, the number, age, sex and life stage of organisms collected and the number, size and location of sampling areas. It must be ensured that test organisms are not the offspring of only one or a few females which can often be a problem with laboratory rearing.

Experimental Design & Analysis

- The choice of a susceptible baseline strain is critical in obtaining meaningful data as many laboratory strains are artificially susceptible compared with field populations.
- Generally, the use of commercial formulation of the test compound is preferred to the use of technical material.
- The choice between using a single discriminating dose or a range of doses depends on the objective of the test:
  - → If the objective is to detect a large change in susceptibility in a small portion of the population, then a single discriminating dose is more appropriate. This should be selected as a dose which gives complete kill or high mortality of a susceptible population but zero or low mortality of a homogeneous resistant population.
  - → If small changes in susceptibility are suspected or there is a range of resistance phenotypes already present in the population, the use of more than one dose is preferred. The choice of doses will depend on the range of resistance factors expressed. However, it is important to remember that probit analysis (LC/LD) may be invalid if the model indicates a significant heterogeneity (Chi-square test).
  - → Results should be recorded in terms of percentage mortality and corrected for mortality in the untreated control using Abbott's formula. A standard form is available on the IRAC website.
- Results from susceptibility tests will not always relate directly to field performance due to complex interaction of factors including environmental conditions, application equipment and pest pressure, in addition to the susceptibility of the population to be controlled. Results from the tests do, however, give an indication of the potential for field control failure due to a change in susceptibility of the pest.

IRAC Recommended Methods

No	Species	Stage	No	Species	Stage
001	*Myzus persicae*	A	013	*Panonychus ulmi*	A
002	*Psylla spp.*	All	014	*Frankliniella occidentalis*	L
003	*Panonychus ulmi* *Tetranychus spp.*	E	015	*Trialeurodes vaporariorum* *Bemisia tabaci*	A
004	*Panonychus ulmi* *Tetranychus spp.*	A	016	*Trialeurodes vaporariorum* *Bemisia tabaci*	E+N
005	*Nilaparvata lugens* *Nephotettix cincticeps*	A	017	*Cydia pomonella*	L
006	Stored Product Beetles	All	018	*Plutella xylostella*	L
007	Leaf eating Coleoptera & Lepidoptera	L	019	Aphid	A+N
008	*Bemisia tabaci*	A	020	*Spodoptera, Helicoverpa, Heliothis spp.*	L
009	*Leucoptera scitella* *Lithocolletis blancardella*	E+L	021	*Meligethes aenus*	A
010	*Frankliniella occidentalis*	A	022	*Tuta absoluta*	L
011	*Meligethes aenus*	A	023	*Myzus persicae*	N
012	*Panonychus ulmi*	A	024	*Aphis gossypii*	N
013	*Panonychus ulmi*	A	025	*Meligethes aenus*	A
			026	*Musca domestica*	A

Life Stages: A – Adult, L – Larvae, N – Nymph, E – Eggs

Note: Biotech Method 1 is available for susceptibility testing on maize feeding Lepidoptera reared on artificial diets

IRAC eMethods Database

IRAC eMethods is a database, searchable by species and MoA, of IRAC recommended methods and those described by researchers but not evaluated or approved by IRAC. The example below is an extract from a search by MoA.

www.irac-online.org → IRAC HOME ABOUT NEWS EVENTS TEAMS COUNTRIES TOOLS → EMETHODS

IRAC Insecticide Resistance Action Committee eMethods

Filter by Species... | 1A & 1B – Acetylcholine esterase inhibitor

Number	Description	Status
0001	Myzus persicae - adult (IRAC Method #1)	IRAC Approved
0002	Psylla spp. - all stages (IRAC Method #2)	IRAC Approved
0004	Panonychus ulmi & Tetranychus spp.- adults (IRAC Method #4a)	IRAC Approved
0005	Nilaparvata lugens & Nephotettix cincticeps - adults (IRAC Method #5)	IRAC Approved
0006	Beetles damaging stored products - all stages (IRAC Method #6)	IRAC Approved

This poster is for educational purposes only. Details are accurate to the best of our knowledge but IRAC and its member companies cannot accept responsibility for how this information is used or interpreted. Advice should always be sought from local experts or advisors and health and safety recommendations followed.

Designed & produced by the IRAC Methods Working Group. June 2011, Version 1

For further information visit the IRAC website: www.irac-online.org

Photographs courtesy: Bayer CropScience●, and Rothamsted Research●

CropLife

IRAC Booth

Representatives of the IRAC International Diamide and IRAC Country Group Teams displaying posters and educational material at the diamondback moth workshop in Bangkok, Thailand.

6th International Diamondback Moth Workshop – Bangkok, Thailand

Over 120 scientists and professionals attended the 6th International Diamondback Moth Workshop held at the Kasetsart University campus near Bangkok (Thailand) on March 21st to 25th, 2011.

Resistance management and integrated pest management of cruciferous pests were the main topics reviewed in this International Workshop by global experts. The insect of main concern was the diamondback moth (DBM), *Plutella xylostella,* which is one of the most serious pests on crucifers worldwide, causing significant losses in yield and marketability. Control of this pest by farmers is mainly accomplished through the use of chemical pesticides due to their effectiveness and quick action. Unfortunately, in areas of high insect pest pressure, the overuse of effective insecticides has resulted in the development of resistant DBM populations. This often reduces the availability of effective insecticidal modes of action leaving the farmer with fewer insecticide rotation options.

IRAC International contributed to this event as a silver sponsor. A welcome packet was given to all participants on behalf of IRAC that included IRM training and reference materials such as the mode of action poster and leaflet. There was also an IRAC booth that provided several different posters developed by the IRAC Lepidoptera and Diamide WG's, and printed materials to raise awareness of IRM. These all helped to give IRAC remarkable visibility in the Workshop.

Two days were dedicated to insecticide resistance and half of it was organized by the IRAC Diamide Working Group. The IRAC session started with a keynote presentation by Verónica Companys introducing the IRAC organization and activities. John Andaloro gave the next talk on insecticide modes of action and general rotation recommendations. Verónica returned to outline the global industry effort to preserve insecticides and the current IRAC Diamide Working Group guidelines and activities. The second part of the session consisted of experiences from South East Asian countries on resistance management strategies and causal factors and learnings including talks from: Suprada Sukonthabhirom from Thailand, Oscar Edralin, Florence Vasquez and EV Cardona from the Philippines and Greg Baker from Australia.

The session and its concepts had a significant impact on the audience based on the intense discussion that followed each speaker.

Philippines IRM Training Program

IRAC sponsored a series of seven resistance management training sessions in the Philippines to address recent reports of grower complaints of diamondback moth resistance to diamide insecticides. The training sessions were managed by the Philippines IRAC Diamide working group and Croplife Philippines. The presenters included members of Academia and Industry, and the training sessions were directed to Industry representatives, educators and government officials. Overall, attendance is expected to reach approximately 350 trainers that will subsequently transmit the resistance management message to an expected 5000 growers. The major focus of the project was on vegetable-growing areas where resistance problems have been reported or areas that are considered most at risk. Training materials included presentations on integrated pest management, insecticides modes of action, and resistance management strategies. A presentation on Industry's responsibility in maintaining insect susceptibility to insecticides was designed by the Philippines IRAC Diamide Working Group in collaboration with IRAC International, and several members of IRAC International participated in the training sessions.

IRAC Training Material

IRAC News Snippets

- ★ IRAC International is considering the set up of a new working group focussed on resistance management in Coleoptera. This would compliment the existing Lepidoptera and Sucking Pest Working Groups that have been running for the last 1-2 years. A first conference call is scheduled for August 23rd.
- ★ The IRAC Public Health Team have been developing a mini-pocket version of the popular Vector Manual. This is just being finalized and printed copies will be available in the next few weeks.
- ★ A new poster on Recommendations for Sustainable & Effective Resistance Management of *Tuta absoluta* has recently been published on the IRAC website by the Lepidoptera WG. In addition, a complementary mini-booklet is being drafted and printed copies should be available shortly. See the next eConnection or the website for further details.
- ★ As reported in previous eConnections, aphid monitoring surveys in peach orchards conducted by Syngenta Crop Protection and Bayer CropScience have revealed that some populations of the green peach aphid (*Myzus persicae*) in Southern France and Northern Spain have developed high levels of resistance to neonicotinoid insecticides. A 2011 monitoring programme, coordinated by IRAC, has been set up in conjunction with Rothamsted Research, to further investigate the extent and scope of this resistance.
- ★ The IRAC International Diamide Working Group is continuing to spread its IRM message and expand its global reach with 21 local country teams now established or in the process of being set up. IRM guidelines have been updated and disseminated globally via the country teams.

Conferences & Symposia

- ★ International Plant Protection Congress, Honolulu, Hawaii, August 6-10, 2011
- ★ 7th Intl. Conference on Urban Pests, Ouro Preto, Brazil, August 7-10, 2011
- ★ Resistance 2011, Rothamsted Research, Harpenden, UK, September 5-7, 2011
- ★ 6th Intl. Symposium on Molecular Insect Science, Amsterdam, October 2-5, 2011
- ★ 9th Intl. Conference Pests in Agriculture, Montpellier, France, October 26-27, 2011
- ★ 59th Entomological Society of America Meeting, Reno, November 13-16, 20011

Feedback

The eConnection is prepared by the IRAC International Communication & Education Working Group and supported by the 15 member companies of the IRAC Executive. If you have information for inclusion in the next issue of eConnection or feedback on this issue please email aporter@intraspin.com

Disclaimer

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